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# Title Page

Title:

Shoulder Injuries in English Community Rugby Union

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# Shoulder Injuries in English Community Rugby Union

## Abstract

The aim of this study was to describe the incidence, severity and type of shoulder injuries resulting from match play in adult community rugby union between 2009-2013. A total of 254 time-loss shoulder injuries were reported, an overall incidence of 2.2 per 1000 hours (95% CI: 1.9 to 2.4) and a mean injury severity of 9.5 weeks missed (95% CI: 8.2 to 10.8). The semi-professional group had an incidence of 2.8 injuries per 1000 hours (95% CI: 2.2 to 3.5), which was higher than the recreational group at 1.8 injuries per 1000 hours (95% CI: 1.4 to 2.2,  $p=0.004$ ). The incidence of acromioclavicular joint injury for semi-professional players was 1.2 per 1000 hours (95% CI: 0.8–1.6); which was significantly higher than the incidence of this injury type in recreational players (0.5 per 1000 hours 95% CI: 0.3–0.7,  $p=0.002$ ). Overall, back row players sustained the highest incidence of all shoulder injuries for a given playing position, 2.9 injuries per 1000 hours (95% CI: 2.2-3.6). The tackle was the main event associated with injury. Injury prevention programmes and coaching strategies that consider tackle technique and physical conditioning of the shoulder region are therefore considered important.

**Keywords:** acromioclavicular, injury epidemiology, sport, tackle, time – loss.

## Introduction

Rugby union is a sport that involves full contact between players of opposing teams and in each match there are numerous occasions of high-impact collisions. Players wear very little protective equipment or padded clothing compared with sports of a similar nature, such as American Football [13]. Due to the nature of the game and characteristics of players, the risk of sustaining an injury across all levels of Rugby Union appears to be relatively high [25,33], although comparable with other full contact sports.

A study of time-loss injuries (>8 days severity) in English community level rugby union reported the incidence of shoulder injuries to be second only to knee injuries with an incidence of 2.3 injuries per 1000 hours with a mean severity of 9.3 weeks missed [25]. In addition, approximately 40% of rugby union players in the premier league in South Africa were found to have primary shoulder injury [20]. The shoulder joint is the joint with the highest risk of dislocation during sports and the injury burden associated particularly with dislocations and subluxations can result in impairment and a significant absence from competition [2,3,12,32]. Lee and colleagues [17] also recognised that sustaining a rugby injury was one of the predominant reasons for players ceasing to continue playing rugby. Rugby players are therefore at risk of ceasing to take part in the sport if they are to sustain a significant shoulder injury. There is still relatively little information about the specific nature of shoulder injuries sustained due to rugby participation in the large amateur playing base, in terms of types, risk factors, mechanisms, and therefore little evidence to inform injury prevention initiatives, rehabilitation, and coaching strategies. The specific aim of this study was to describe the incidence, severity and type of shoulder injuries resulting from match play in adult community rugby union between 2009 and 2013.

## **Materials & Methods**

### ***Participants***

Invitations to participate in the study were sent to English adult community-level clubs who were competing in the Rugby Football Union (RFU) league structure (levels 3 – 9)[28]. The study was conducted over four seasons between 2009 and 2013 in a sample of these clubs who agreed to participate (2009/10, n=46 [61 clubs at the beginning of the season]; 2010/11, n=67 [90 clubs at the beginning of the of the season]; 2011/12, n=76 clubs [104 clubs at the beginning of the of the season]; 2012/13, n=50 clubs [106 at the beginning of the of the season]). A total of 239 club-seasons made up the final sample. The participating clubs were sub-categorised into: RFU level 3 and 4, made up largely of 'semi-professional' players; RFU level 5 and 6, made up largely of 'amateur' players; and RFU level 7, 8 and 9, made up largely of 'recreational' players. Players were given information about the study and could opt-out from participation by informing the club medical staff who omitted details on that player. The study had institutional ethics approval and the procedures met the ethical standards of the journal [11].

### ***Time – loss injuries***

Standard injury report forms were completed and returned by injury management staff (with a physiotherapy, sport rehabilitation or sport therapy qualification as a minimum) working at the clubs taking part. Any shoulder injury sustained during a first team match resulting in an absence from participation in match play for one week or more from the day of injury was defined as a "time – loss" shoulder injury. The return to play date was the date of the match on which the player was considered fit for selection, and severity was defined by the number of weeks missed. The consensus statement on injury definitions in rugby union describes the least severe injuries collected in this study as 'moderate' (8 – 28 days absence) [9].

Injuries were recorded according to the type, injury event, playing position, time in match, and severity for all time-loss injuries. The Orchard Sports Injury Classification System (OSICS) version 8 [24] was used to categorise the type of injury by the injury management personnel in discussion with the player. Only injuries that were diagnosed on the OSICS starting with "S" (denoting the shoulder site) were included in this analysis. Injuries incurred through any activity other than rugby match play (including rugby training) were not included in the analysis. The definition used for recurrent injuries was that an injury was recorded to be of the same type and to the same body location as an index injury [9].

### ***Medical Attendances***

During seasons 2009/10, 2010/11 and 2011/12, the injury management staff also recorded information each time during a match that a medical attendance was made relating to the shoulder region using the Orchard Sports Injury Classification System.

### ***Data Analysis***

Playing positions were grouped as forwards and backs then sub grouped into front row (props and hooker), second row (locks), back row (number 8 and flankers), inside backs (scrum half and fly half), midfield backs (centres) and outside backs (wings and full back). Match exposure was determined by the number of matches x number of players per team x match duration (hours). The incidence and severity of injuries per season were calculated, with injury incidence documented as the number of

medical attendances or time-loss injuries per 1000 player hours of match exposure; severity was represented as mean and median values, and 95% Poisson confidence intervals (CI) for outcome variables were calculated. Differences between groups were determined using a two-tailed Z test for comparison of rates. Differences were deemed to be statistically significant if  $P \leq 0.05$ .

## Results

### ***Incidence and severity of time-loss shoulder injuries***

A total of 116740 hours of match exposure was recorded. From this exposure, 254 time-loss shoulder injuries were reported, with an overall incidence of 2.2 per 1000 hours (95% CI: 1.9 to 2.4) and a mean injury severity of 9.5 weeks missed (95% CI: 8.2 to 10.8) (Table 1). The semi-professional group had an incidence of 2.8 injuries per 1000 hours (95% CI: 2.2 to 3.5), which was higher than the recreational group at 1.8 injuries per 1000 hours (95% CI: 1.4 to 2.2,  $p=0.004$ ). There was a significant increase in incidence during the 2012/13 season for all groups combined, with 3.5 injuries per 1000 hours (95% CI 2.7 to 4.2) compared with all previous seasons (2009/10: 1.7 injuries per 1000 hours, 95% CI 1.1 to 2.2; 2010/11: 2.1 injuries per 1000 hours, 95% CI 1.6 to 2.6; 2011/12: 1.7 injuries per 1000 hours, 95% CI 1.3 to 2.1,  $p < 0.05$ ).

### ***Injury type***

The incidence of acromioclavicular joint injury for semi-professional players was 1.2 per 1000 hours (95% CI: 0.8-1.6); which was significantly greater than the incidence of this injury type in recreational players (0.5 per 1000 hours,  $p=0.002$  (95% CI: 0.3-0.7) (Table 2). Shoulder sprains and dislocations was the main injury type for recreational players (0.8 per 1000 hours (95% CI: 0.6-1.1)). The most severe injuries that were reported were arm fractures resulting in a mean of 17.6 weeks missed.

### ***Injury event***

Contact mechanisms accounted for 99% of the shoulder injuries with the remaining 1% comprising non – contact injuries ( $n=4$ ) resulting from try scoring attempts (Table 3), therefore possibly due to contact with ground rather than other players. Tackling was associated with the highest proportion of all shoulder injuries (48%) as well as being associated with the highest proportion of shoulder sprain and dislocation injuries (56%) and acromioclavicular joint sprain injuries (44%).

## ***Recurrences***

A total of 27% of the shoulder injuries were reported by medical staff as being recurrent injuries (same location and same type of injury). Shoulder sprain and dislocation had a relatively high rate of recurrence at 36%. The mean severity of new (index) and recurrent injuries was 8.7 and 12.2 weeks missed, respectively. Arm fracture resulted in the highest severity of injuries, 15.0 weeks missed for new injuries and 30.7 weeks missed for recurrent fracture injuries (Table 4).

## ***Playing position***

The incidence of match shoulder injuries was the same between forwards and backs at 2.2 (95% CI: 1.8-2.5, n=134) and 2.2 (95% CI: 1.8-2.6, n=120) injuries per 1000 hours, respectively (Figure 1). Overall, back row players sustained the highest incidence of all shoulder injuries for a given playing position (2.9 injuries per 1000 hours), which was significantly higher than that for second row players (1.2 injuries per 1000 hours,  $p=0.001$ ). Back row players also sustained significantly more acromioclavicular joint injuries with 1.3 injuries per 1000 hours (95% CI: 0.8 to 1.7) when compared with the incidence for second row at 0.2 injuries per 1000 hours (0 to 0.4) ( $p=0.002$ ).

### ***Timing within Game***

Injury incidence was not different across match quarters: 1.6 injuries per 1000 hours (95% CI: 1.2 - 2.1) in the first quarter, 2.2 injuries per 1000 hours (95% CI: 1.7 – 2.7) for the second quarter and third quarters, and 2.3 injuries per 1000 hours (95% CI: 1.8 – 2.9) for the fourth quarter. The mean injury severity was significantly lower in the first quarter (5.9 weeks missed, 95% CI: 4.2 – 7.6) than all other quarters (second quarter: 11.1 weeks missed, 95% CI: 8.7 – 14.4; third quarter: 9.1 weeks missed, 95% CI: 6.8 – 11.3; fourth quarter: 9.5 weeks missed, 95% CI: 7.3 – 11.8).

### ***Medical Attendances***

The incidence of medical attendances over 3 seasons for shoulder injuries was 23.1 attendance injuries per 1000 match hours (95% CI: 22.1-24.1), in the context of 229.3 attendance injuries per 1000 match hours (95% CI: 226.23-232.39) for all injuries. Medical attendance for shoulder injuries equated to an incidence of 1 shoulder medical attendance for every 2.2 team games. The incidence of medical attendances for shoulder injuries was significantly higher for semi - professional players (29.1 injuries per 1000 hours) than that of recreational (21.8 injuries per 1000 hours,  $p < 0.001$ ) and amateur players (20.5 injuries per 1000 hours,  $p < 0.001$ ).

### ***Discussion***

These findings on match-play shoulder injuries have implications for the healthcare and conditioning specialist in relation to shoulder injury prevention and rehabilitation in addition to coaching proper tackling technique. Medical attendance for a shoulder injury was one in every 2.2 team games, whereas the incidence of shoulder injuries resulting in more than 8 days of time loss was 2.2 per 1000 hours, which is approximately one injury every 22 team games. Collectively, this injury trend and the mean severity of time loss injuries of 9.5 weeks missed informs the initial stage of the sport injury prevention model, to highlight the scale of the problem. Particular initiatives should be directed to interventions with the semi-professional players who had the highest incidence of shoulder injuries (both time-loss and medical attendance), which was significantly greater than recreational players, specifically for acromioclavicular joint injuries. Furthermore, the specific positional demands of back row players must be taken into consideration in order to address the higher incidence of shoulder injuries sustained by these players, and this may involve specific injury prevention strategies for these positions.

Overall the higher level of competition (semi-professional) presented with a significantly higher incidence of shoulder injuries than the recreational level, but this is lower than reported for professional players for missed matches (4.3/1000 hours) [12]. The higher incidence of injuries amongst the semi-professional playing level is in accordance with previous studies that injury incidence increases at higher playing levels [25]. The injury risk for higher playing levels has been proposed to be due to there being a higher match play intensity, skill and fitness attributes which manifests in a greater number of contact events and more force in impacts [25]. A recent study of upper limb injuries carried out over five rugby seasons also found a higher incidence of shoulder injury of 8.6 per 1000 hours than other upper limb injuries [30]. Surprisingly this is accounted for due

1 to the inclusion of Colts players (under 20 year old) who presented with the highest incidence of  
2 shoulder injuries in the group which is contrary to injury trends elsewhere [23]. Usman and McIntosh  
3 [30] proposed that younger players are thought to be at a relatively higher risk as they are  
4 transitioning from school playing level to higher levels of competition. At this stage, players may  
5 have developed a faster running speed and strength but these younger players lack experience, skills  
6 and fitness to go with these physical developments, which may contribute to an injury risk. It is  
7 plausible that these factors may have influenced the higher incidence in their study.

8 Contact injuries accounted for 99% of the shoulder injuries in this study with the tackle event  
9 accounting for the vast majority, of which the tackler had the highest proportion of shoulder injuries.  
10 Injury analysis elsewhere is in agreement that the tackle is the leading cause of shoulder injury  
11 [16,32,33]. Coaching of correct and successful tackle technique is based on the analysis of  
12 proficiency between injury and non-injury tackle events. Prior to contact, tacklers should shorten  
13 their steps while their head position is up and forward facing to the ball carrier. Both tackler and ball  
14 carrier should train to heighten their peripheral vision to adapt better to the environment. The  
15 tackler should stay square to the ball carrier and make contact with the mid-torso of the opponent  
16 using their shoulder and driving with their legs. This point of contact is suggested as there is a  
17 greater risk of injury to the tackler when contacting the ball carrier low. Post-contact requires the  
18 tackler to drive the legs, use the shoulder and arms to wrap or pull [5,7,14].

19 Shoulder sprains and dislocation were the highest incidence for all groups accounting for 0.8 per  
20 1000 hours, which was also most prominent in research by Lynch et al. [20] which analysed the  
21 incidence of shoulder injuries in rugby union players participating in the premier league in South  
22 Africa. Detailed video analysis of injury mechanisms has recognised that the suboptimal  
23 glenohumeral joint alignment and poor technique of the tackler are expected risk factors for  
24 shoulder dislocation [19]. Moreover, the magnitude of force to the tackler's shoulder is substantial  
25 and up to approximately 2000 N during a tackle [31]. Players therefore need to be better  
26 conditioned to optimise their glenohumeral joint position in preparation for the impact forces and  
27 consider tackling technique factors that may be associated with the occurrence of this injury type  
28 [10]. Attention should be targeted to train the neuromuscular control that is required for the player  
29 to adopt the optimal tackling position [15]. This particularly involves the glenohumeral and  
30 scapulathoracic dynamic neuromuscular control that is required to achieve the ideal shoulder  
31 position for the tackle [22]. The integrity of the glenohumeral joint and its capsuloligamentous  
32 support is under maximum strain when the joint is under load at the end of its range of motion [18].  
33 Neuromuscular control of the shoulder therefore needs to be effective during a tackle for players to  
34 avoid reaching the vulnerable end range of motion in order to reduce the risk of shoulder dislocation  
35 / instability.

36 The incidence of acromioclavicular joint injury for semi-professional players was higher than the  
37 lower playing levels. The higher number of tackles made by the semi-professional players than lower  
38 playing levels in addition to a greater risk of injury per 1000 tackle events could explain the higher  
39 incidence of acromioclavicular joint injury for semi-professional players [26]. Similarly, McIntosh et  
40 al. [21] has demonstrated that the higher number of tackles at this level increases the risk of injuries,  
41 which is in support of our findings in this study. Research findings from studies carried out in England  
42 and Wales and from the Super Rugby matches in the southern hemisphere concur that  
43 acromioclavicular joint injury was also amongst the most common shoulder injuries incurred by



professional players [3,32]. During the tackle, when the shoulder is in horizontal adduction and flexion, the acromioclavicular joint is subject to direct loading. Previous research has been inconclusive with regards to the use of shoulder padding for preventing shoulder injuries but this mechanism is in theory one that could be attenuated by the use of padding and warrants further research [12,31,32].

Shoulder sprains and dislocation had a relatively high rate of recurrence at 36%. The higher rate of new dislocations than recurrent is likely attributable to the high risk activities (typically contact situations involving the tackle) performed by players during matches [3]. Headey and co-workers [12] were in agreement with the present data that the severity of reported recurrences of dislocation/ instability was higher than new injuries. It is worth noting the limitation of the analysis method for reporting recurrences here, which does not provide a direct comparison between the individual recurrent injuries and their own index injury, merely a comparison of mean severity values of each category. Management and rehabilitation may also need to be enhanced by considering positional specific return to play criteria to attempt to reduce the proportion of recurrence [1,29].

There was no significant difference in incidence of shoulder injuries between forwards and backs. Back row forwards sustained significantly more injuries than second row forwards. Research has shown that back row flankers were among the three most common positions to sustain shoulder instability that required reconstructive surgery [29]. Position specific physical conditioning for the shoulder and a graduated return to sport is warranted to reduce the risk and severity of shoulder injury [4,27].

Unlike some other previous studies we found no difference in incidence between match quarters [6,8]. We have shown lower severity in quarter 1 which may be due to players not being fatigued and therefore fatigue not being a factor.

In the current study a limitation was a lack of reporting on training injuries which possess an injury burden in themselves and may be a risk factor for match injury. In this context, injuries that happen during training may result in the gradual onset of deficits in players' functional movement patterns thereby reducing players' ability to perform in an efficient way to withstand the forces of impact during the game and so contribute to injuries occurring. It is possible that specific assessment of dysfunctional movement around the shoulder with subsequent correction may be of benefit.

This study presents the first focussed analysis of the nature of shoulder injuries in English community-level rugby union match play. Tackling is the main event associated with injury, while injuries to the acromioclavicular joint had the highest incidence. All parties involved in the game need to focus on coach and player education around tackle technique and specific physical conditioning, and research should continue to determine the factors that contribute to shoulder injuries so as to direct prevention strategies.

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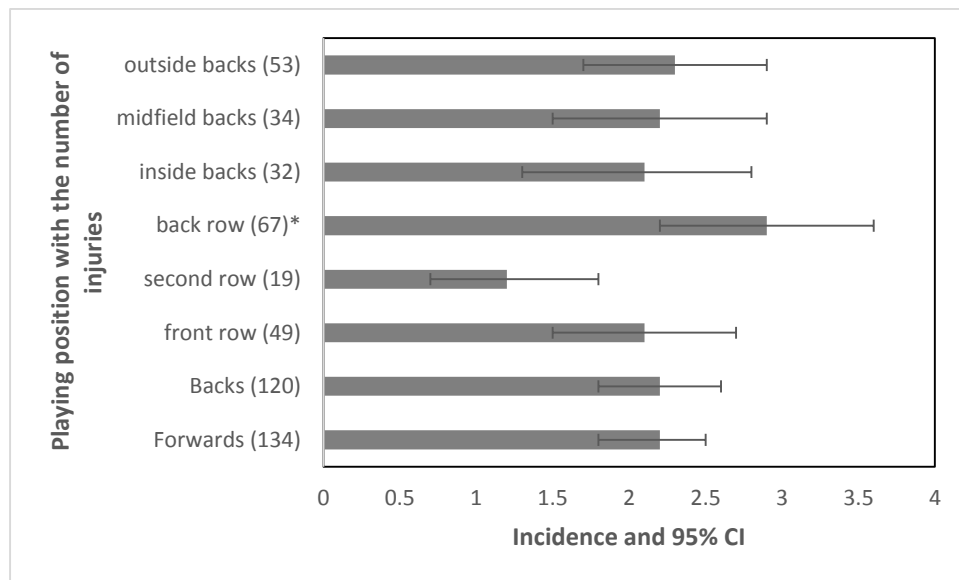


Figure 1 *Distribution of shoulder injuries as a function of playing position*

**Table 1 Match exposure, overall shoulder injury incidence and severity**

	Matches	Match Hours	Number of injuries	Injury Incidence per 1000 hours (95% CI)	Mean Severity in Weeks (95% CI) [Median]
All	5837	116740	254	2.2 (1.9 to 2.4)	9.5 (8.2 to 10.8) [6]
Semi- Professional	1335	26700	76	2.8 (2.2 to 3.5)*	9.7 (8.4 to 11.0) [5]
Amateur	2134	42680	93	2.2 (1.7 to 2.6)	9.5 (8.2 to 10.8) [5]
Recreational	2368	47360	85	1.8 (1.4 to 2.2)	9.2 (8.0 to 10.4) [6]

\* Significantly higher than 'recreational'

**Table 2 Type and Severity of Match Shoulder Injuries**

\*Significantly higher than recreational

Injury Type	Number of Injuries	Incidence (95% CI)				Mean Severity
		Semi-Professional	Amateur	Recreational	All	All (95% CI) [median]
Haematoma	3	0(0-0.1)	0(0-0.1)	0(0-0.1)	0.01 (0-0.1)	4 (3.5-4.5) [4]
Sprains and dislocation	99	0.9(0.6-1.3)	0.8(0.5-1.1)	0.8(0.6-1.1)	0.8 (0.7-1.0)	10.7(9.3 – 12.1) [6]
Acromioclavicular joint injury	87	1.2(0.8-1.6)*	0.8(0.5-1.0)	0.5(0.3-0.7)	0.7 (0.6-0.9)	7.5(6.5 – 8.5) [6]
Tendon injuries	27	0.3(0.1-0.5)	0.2(0.1-0.3)	0.2(0.1-0.3)	0.2 (0.1-0.3)	12.6(10.9-14.3) [7]
Fracture arm <sup>1</sup>	19	0.1(0-0.3)	0.1(0-0.3)	0.2(0.1-0.3)	0.2 (0.1-0.2)	17.6(15.3-19.9) [14]
Other injury <sup>2</sup>	19	0.3(0.1-0.5)	0.2(0.1-0.3)	0.1(0-0.1)	0.2(0.1-0.2)	3.6(3.1-4.1) [3]

<sup>1</sup> Fracture arm accounts for fractured clavicle (n= 16), proximal humeral fractures (Hill-Sachs lesion n=2, fracture neck of humerus n=1).

<sup>2</sup> Other injury accounts for shoulder and arm neurovascular n=9 and upper arm muscle strains n=10.

**Table 3 Injury diagnoses of shoulder injuries sustained during matches with the associated match events**

Injury Event	All injuries (n = 254)	Incidence of All Injuries (95% CI)	Diagnosis <sup>3</sup>						Mean Severity (weeks missed) (95% CI) [Median]
			Hematoma (n=3)	Sprains and Dislocation (n=99)	Acromioclavicular joint injury (n=87)	Tendon injuries (n=27)	Fracture Arm (n=19)	Other injury (n=19)	
All Tackled	84	0.72(0.57-0.87)	2	25 (25%)	34 (39%)	9 (33%)	9 (47%)	5(26%)	10.3(8.9 -11.7)[7]
Tackled	79		2	25	32	9	7	4	
Tackled	5				2		2	1	
collision <sup>4</sup>									
All Tackling	121	1.04(0.85-1.22)	1	56 (56%)	39 (44%)	14 (52%)	5 (26%)	6 (32%)	9.2(8-10.7)[5]
Tackling	118		1	55	38	13	5	6	
Tackling	3			1	1	1			
collision									
Ruck/ maul	26	0.22(0.14-0.31)		7 (7%)	11 (13%)	1 (4%)	2 (11%)	5 (26%)	9.0(7.8-10.2)[7]
Collapsed maul	4			1	3				
Scrum	10	0.09(0.03-0.14)		4 (4%)	2 (2%)	2 (7%)	1 (5%)	1 (5%)	6.7(5.8-7.6)[3.5]
Collapsed scrum	1							1	
Lineout	1	0.01(0-0.03)		1 (1%)					24[24]
Collision	4	0.03(0-0.07)		2 (2%)		1 (4%)	1 (5%)		11.0(9.5-12.5)[3.5]
Non –	4	0.03(0-0.07)		3 (3%)			1 (5%)		15.5(13.4-17.6)[16]
contact <sup>5</sup>									
Unknown	4	0.03(0-0.07)		1 (1%)	1 (1%)			2 (11%)	2.5(2.2-2.8)[2.5]

<sup>3</sup> The number of injuries for each event has been represented as a percentage of the total number of injuries for that diagnosis

<sup>4</sup> A tackled collision was when a tackler stops the progress of the ball carrier without the use of his arms (illegal tackle).

<sup>5</sup> These injuries may have been due to contact with the ground.

**Table 4 Proportion and severity of 'New' and 'Recurrent' injuries**

Injury Type	Number of Injuries	Proportion, %		Mean Severity, weeks (median)	
		New	Recurrent	New	Recurrent
Haematoma	3	100	-	4.0 (4.0)	-
Sprains and Dislocation	99	64	36	9.0 (5.0)	14.0(6.0)
Acromioclavicular joint injury	87	80	20	7.6 (6.0)	7.4 (6.0)
Tendon injuries	27	70	30	12.7 (7.5)	12.4 (4.0)
Fracture arm	19	84	16	15.0 (14.0)	30.7(29.0)
Other injury	19	79	21	3.9 (3.0)	2.5 (2.5)
All injuries	254	73	27	8.7 (6.0)	12.2 (6.0)